

## PATENT COOPERATION TREATY

PCT

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner  
 US Department of Commerce  
 United States Patent and Trademark  
 Office, PCT  
 2011 South Clark Place Room  
 CP2/5C24  
 Arlington, VA 22202  
 ETATS-UNIS D'AMERIQUE  
 in its capacity as elected Office

<b>Date of mailing</b> (day/month/year) 06 April 2001 (06.04.01)	
<b>International application No.</b> PCT/CA00/00800	<b>Applicant's or agent's file reference</b> 295-1276
<b>International filing date</b> (day/month/year) 06 July 2000 (06.07.00)	<b>Priority date</b> (day/month/year) 19 July 1999 (19.07.99)
<b>Applicant</b> GIBBON, Michael, A. et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:  
 12 February 2001 (12.02.01)

☐ in a notice effecting later election filed with the International Bureau on:  
 \_\_\_\_\_

2. The election ☒ was  
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO  
 34, chemin des Colombettes  
 1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Athina Nickitas-Etienne

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## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>295-1276</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/CA 00/ 00800</b>	International filing date (day/month/year) <b>06/07/2000</b>	(Earliest) Priority Date (day/month/year) <b>19/07/1999</b>
Applicant  <b>IMAX CORPORATION</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 2 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

**1. Basis of the report**

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☐ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

☒ None of the figures.

## INTERNATIONAL SEARCH REPORT

International Application No:  
PCT/CA 00/00800A. CLASSIFICATION OF SUBJECT MATTER  
H04N9/31,G02B26/08According to International Patent Classification (IPC) or to both national classification and IPC<sup>7</sup>

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
H04N,G02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5903388 A (SEDLMAYR) 11 May 1999, fig. 8, claims 1,4,5. --	1, 4
A	WO 98/00746 A1 (SIEMENS NIXDORF INFORMATIONSSYSTEME AG) 08 January 1998, claim 8. ----	1, 2

☐ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

## \* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

29 September 2000

Date of mailing of the international search report

08. 12. 2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
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Authorized officer

FUSSY

# ANHANG

Zum internationalen Recherchenbericht über die internationale Patentanmeldung Nr.

In diesem Anhang sind die Mitglieder der Patentfamilien der im obengenannten internationalen Recherchenbericht angeführten Patentdokumente angegeben. Diese Angaben dienen nur zur Unterrichtung und erfolgen ohne Gewähr.

# ANNEX

To the International Search Report to the international Patent Application No.

PCT/CA 00/00800 SAE 292466

This annex lists the patent family members relating to the patent documents cited in the above-mentioned search report. The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

# ANNEXE

Au rapport de recherche international relatif à la demande de brevet international n°

La présente annexe indique les membres de la famille de brevets relatifs aux documents de brevets cités dans le rapport de recherche international visée ci-dessus. Les renseignements fournis sont donnés à titre indicatif et n'engagent pas la responsabilité de l' Office.

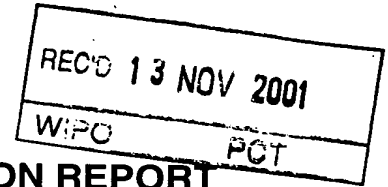
Im Recherchenbericht angeführte Patentdokumente Patent document cited in search report Document de brevet cité dans le rapport de recherche	Datum der Veröffentlichung Publication date Date de publication	Mitglied(er) der Patentfamilie Patent family member(s) Membre(s) de la famille de brevets	Datum der Veröffentlichung Publication date Date de publication
US A 5903388	11-05-1999	US A 6034818	07-03-2000
WO A1 9800746	08-01-1998	DE C1 19626097	30-10-1997

# PATENT COOPERATION TREATY

# PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)




Applicant's or agent's file reference 295-1276	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/CA00/00800	International filing date (day/month/year) 06/07/2000	Priority date (day/month/year) 19/07/1999
International Patent Classification (IPC) or national classification and IPC H04N9/31		
Applicant IMAX CORPORATION		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 4 sheets, including this cover sheet.  
  
☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 12/02/2001	Date of completion of this report 09.11.2001
Name and mailing address of the international preliminary examining authority:   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer  Noll, B  Telephone No. +49 89 2399 8700



# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/CA00/00800

## I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

**Description, pages:**

1-7 as originally filed

**Claims, No.:**

1-5 as originally filed

**Drawings, sheets:**

1/2-2/2 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/CA00/00800

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

## V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

### 1. Statement

Novelty (N)	Yes: Claims 2, 3, 5
	No: Claims 1,4
Inventive step (IS)	Yes: Claims
	No: Claims 2,3,5
Industrial applicability (IA)	Yes: Claims 1-5
	No: Claims

2. Citations and explanations  
**see separate sheet**

## VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:  
**see separate sheet**

**To section V:**

With regard to claim 1 the document US-A-5 903 388 (hereinafter referred to as D1) discloses a projection system including (see figure 8) a light source 32, a projection lens 148, an SLM 138-142, a first polarizer 36 for polarizing, in a defined orientation, light leaving the SLM (at path 52) and a second polarizer 146 for polarizing in the same defined orientation, light passing through the projection lens. Hence all features of claim 1 are known from D1.

The implementation for the SLM as set out in claim 2 (DMD) is generally known in the art and therefore not invention. The implementation set out in claim 4 (LCD) and the feature of claim 3 (separation into colour components) are known from D1, see column 44, lines 51-53. The feature of claim 5 of suppressing light having unwanted polarization is generally known in the art.

**To section VII:**

Reference signs in parentheses should have been inserted in the claims to increase their intelligibility, Rule 6.2(b) PCT. This applies to both the preamble and characterising portion.

To meet the requirements of Rule 5.1(a)(ii) PCT, the document D1 mentioned above should have been identified in the description and the relevant background art disclosed therein should have been briefly discussed.



(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
25 January 2001 (25.01.2001)

PCT

(10) International Publication Number  
**WO 01/06796 A1**

(51) International Patent Classification<sup>7</sup>: **H04N 9/31,**  
G02B 26/08

(21) International Application Number: **PCT/CA00/00800**

(22) International Filing Date: **6 July 2000 (06.07.2000)**

(25) Filing Language: **English**

(26) Publication Language: **English**

(30) Priority Data:  
2,277,656 19 July 1999 (19.07.1999) **CA**

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(72) Inventors; and

(75) Inventors/Applicants (for US only): **GIBBON, Michael, A. [CA/CA]; 1340 Monk's Passage, Oakville, Ontario L6M 1J5 (CA). READ, Steven, Charles [CA/CA]; 3961 Renfrew Crescent, Mississauga, Ontario L5L 4J6 (CA).**

(74) Agent: **BERESKIN & PARR; 40 King Street West, 40th Floor, Toronto, Ontario M5H 3Y2 (CA).**

(81) Designated States (national): **AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.**

(84) Designated States (regional): **ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).**

**Published:**

- *With international search report.*
- *Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(54) Title: **IMAGE PROJECTION SYSTEM**

(57) Abstract: An electronic projector has a projection system that includes a spatial light modulator (SLM) for imparting image information to the projected light beam. The light beam leaving the SLM is prepolarized in a defined orientation and the projected light is polarized in the same orientation so as to effectively block any light that has been scattered within the projector and become depolarized. The SLM may be a digital mirror device (DMD) or a liquid crystal device (LCD). Reflective surfaces within the projector may be covered or coated with material that polarizes the reflected light at an orientation orthogonal to the defined orientation.



**WO 01/06796 A1**

**Title: IMAGE PROJECTION SYSTEM**

**FIELD OF THE INVENTION**

This invention relates generally to image projection systems, and is concerned more particularly with systems that include a spatial light modulator (SLM) for imparting image information to a projected light beam. Systems of this type typically are used for large screen televisions, which are often referred to as "electronic projectors".

**BACKGROUND OF THE INVENTION**

In a typical electronic projector, the SLM may be a liquid crystal device (LCD) comprising a matrix of individually addressable liquid crystal pixels. Each pixel can be switched between a transmissive mode in which incident light from the light source passes through the pixel and is projected, and a non-transmissive mode. In the non-transmissive mode, the light may be reflected away from the projection lens. In any event, each pixel has an "on" state and an "off" state. By appropriately controlling the pixels in accordance with stored data, image information is imparted to the projected light beam.

U.S. Patent No. 5,584,991 (Levis et al.) discloses an example of an LCD projection system.

Another example of an SLM that includes an active matrix of pixels is known as a deformable mirror device (DMD). In this case, the matrix comprises an array of tiltable mirrors, each of which is a cantilever beam element carrying electrodes that allow the element to be electro-statically deflected between two positions. The extent of the deflection can be controlled by the applied electro-static potential to provide variable degrees of deflection, or the device can be operated in a binary manner so that each mirror switches between an "on" state and a "off" state. The mirror angularly deflects the incident light beam so that the beam is either reflected through the projector optics, or not.

DMDs are described in some detail in a paper by Larry J. Hornbeck entitled "Current Status and Future Applications for DMD-Based

Projection Displays". The paper is available on the Internet web site of Texas Instruments.

Known projection systems in which light from a light source is modulated by an SLM suffer the disadvantage that there is often a limit on the amount of light flux that can be directed into the SLM. This limit is caused by, for example, limitations associated with the heating effect of the radiant flux, or saturation due to high luminous flux.

Another problem with SLMs is that there is a tendency for some of the incident light to be scattered or reflected, which reduces the overall contrast of images projected onto the screen.

An object of the present invention is to address these disadvantages with the aim of improving the contrast of the projected images.

#### **SUMMARY OF THE INVENTION**

The present invention provides a projection system that includes a light source for projecting a light beam, a screen, a projection lens for projecting the light beam onto the screen, and an SLM for imparting image information to the light beam upstream of the projection lens. Light leaving the SLM is polarized in a defined orientation by first polarizer means, and light passing through the projection lens is polarized in the same defined orientation by second polarizer means.

Generally speaking, the first polarizer means pre-polarizes or "characterizes" the light. Light that is subsequently scattered within the projector and depolarized will be partially blocked (up to a maximum of 50%) by the second polarizer means. Accordingly, the contrast ratio of the projected image will be increased by a factor of up to 2.

An advantage of the invention is that it is somewhat easier to characterize the unwanted "noise" (scattered light) by polarization than by trying to characterize the signal in some other way. Inefficiencies in the polarizing material are below significance since the amount of noise is relatively small compared to the signal. Inefficiencies such as inequities in performance depending on wavelength or angle of incidence can be tolerated

much more readily when applied to the noise component of the overall signal.

Additional significant improvements in the contrast ratio of the projected image can be made by coating or covering surfaces within the projector from which light tends to scatter, with a material that polarizes the light in an orientation that is orthogonal to the orientation of the light that is incident on the SLM.

#### **BRIEF DESCRIPTION OF DRAWINGS**

In order that the invention may be more clearly understood, reference will now be made to the accompanying drawings which illustrate a preferred embodiment of the invention by way of example, and in which:

Fig. 1 is a schematic illustration of an electronic projector in accordance with a preferred embodiment of the invention; and,

Fig. 2 is a schematic perspective view of a pixel of a DMD that may be used in the projector of Fig. 1.

#### **DESCRIPTION OF PREFERRED EMBODIMENT**

Fig. 1 illustrates schematically the principal components of a projection system in accordance with the invention. Reference numeral 20 denotes a light source that projects a beam of light 22 onto a projection screen 24 via a projection lens 26. The light source 20, projection lens 26 and screen 24 are essentially conventional. Also conventional is a beamsplitter arrangement comprising an assembly of prisms 30 that optically splits the light beam 22 into red, green and blue components (R, G, B). The respective components are directed by the beamsplitter to three corresponding DMDs 32.

The DMDs are essentially identical but deal with different portions of the spectrum. In other words, the light that enters the beamsplitter is split into red, green and blue components which are delivered to the respective R, G and B DMDs. The beamsplitter then in effect "re-assembles" the R, G and B components of the light beam and directs them together into the projection lens 26 for projection onto the screen 24.

Each of the DMDs 32 comprises an array of reflective digital

light switches (mirrors) that are integrated onto a silicon chip capable of addressing the switches individually. Each switch represents a single pixel in the array and can be individually switched on or off in accordance with digital information that is provided to the chip by an appropriate hardware and software controller. Each individual pixel in each DMD is controlled to impart appropriate image information to the light beam that is projected onto the screen 24.

Fig. 2 shows a single one of the mirrors of a DMD and part of the silicon chip used to control the mirrors. Since DMDs are known, detailed information with respect to the construction and operation of the DMD is not provided. Reference may be made to the Hornbeck article referred to previously for additional information. For present purposes, it is sufficient to note that Fig. 2 shows the mirror at 34 and that the mirror is mounted at the outer end of a cantilever beam element 36 carrying electrodes (not shown) that allow the element to be electrostatically deflected between two tilted positions, in which the mirror either reflects light into the projection lens 26 (Fig. 1) or away from the projection lens. In Fig. 2, the mirror is shown in full lines in one of its tilted positions and in ghost outline in the other of its tilted positions.

A portion of the silicon chip on which the mirror is mounted is denoted by reference numeral 38. The chip includes individual memory cells, one for controlling each mirror. By virtue of the construction of the DMD, the top surface of the chip 38 below each mirror (indicated generally at 38a) has surface portions that are at different elevations and have a variety of different irregular shapes, as indicated generally by reference 40 in Fig. 2. Pursuant to an aspect of the invention that is to be described later, the top surface of the chip is covered or screened by a sheet that is denoted 42.

In accordance with a primary aspect of the invention, the projection system includes first polarizer means for polarizing, in a defined orientation, light leaving each DMD and second polarizer means for polarizing, in the same defined orientation, light passing through the projection lens. The first polarizing means pre-polarizes or "characterizes"

the light in a defined orientation. Light that is subsequently scattered within the projector and de-polarized is then blocked by the second polarizer means and will not impair the contrast of the images that are projected onto the screen.

5                   In the embodiment shown in Fig. 1, the first polarizer means is indicated by a polarizing filter P1 in the beam of light that enters the beamsplitter from the light source 20. For example, the polarizer may be positioned between lens elements 44 that configure the light beam appropriately before the light enters the beamsplitter. In this way, the light is  
10 pre-polarized or "characterized" by polarizer P1.

Polarizer P2 is also a polarizing filter and in this embodiment is positioned at the outer end of projection lens 26. Polarizer P2 has a defined orientation that is the same as the defined orientation of polarizer P1. Accordingly, polarizer P2 will block and prevent projection onto the screen of  
15 any light that has become de-polarized as the light beam passed through the optical system of the projector. It will of course be understood that polarizer P2 could be located, for example, within the projection lens 26 (e.g. between the lens element of the projection lens) or upstream of the projection lens as indicated in ghost outline at P2'.

20                   Similarly, the location of polarizer P1 can change. Preferably, the light is pre-polarized before it reaches the SLM(s) of the projection system. However, it is important merely that the light be polarized as it leaves the SLM(s). For example, it is to be understood that the invention may be applied to a projection system that uses SLMs in the form of liquid crystal  
25 devices (LCDs). An LCD typically comprises front and rear polarizers and a liquid between the polarizers that "twists" the light that enters through the first polarizer so that it can exit through the second polarizer when the LCD is "on". Accordingly, the light is inherently polarized as it leaves the LCD. Accordingly, while there may nevertheless be advantages to using an  
30 upstream polarizer P1 in such an embodiment, it is to be understood that this is not essential and that reliance may be placed on the polarizing effect of the LCD itself.

In summary, the arrangement of first and second polarizers provided by the invention has been found to lead to significant improvements in the contrast ratio of the images that are projected onto the screen. It has also been found that additional significant improvements in contrast ratio can be achieved by coating surfaces within the projector from which light tends to scatter, with a material that polarizes the light at an orientation orthogonal to the orientation of the light that is leaving the SLM. For example, sheets of quarter-wave polarizing material or other appropriate coating materials can be used. In Fig. 1, the undulating lines denoted by reference numeral 46 indicate typical areas in which such coatings may be applied. One significant area is the top surface of the memory chip 38 of each DMD. Thus, reverting to Fig. 2, the sheet indicated at 42 may comprise such a material. Sheet 42 effectively screens from reflection by the surfaces 40 light that may "miss" or partially miss the mirror 34 and that would otherwise give rise to significant optical noise within the projector.

An additional benefit of the invention is that it reduces the heat load on SLMs in those situations where the light output by the projector is required to be polarized in a particular orientation. This is the case for example in a 3-D projection system where two sets of images are produced, one for each eye, and are characterized or coded by orthogonally polarized light. In a traditional system the light is usually polarized after the projector lens, resulting in an efficiency loss of roughly 50%. This loss of efficiency requires high input light levels to be used, which can lead to excessive heating of the SLMs. The invention avoids this excessive heating by polarizing the light before the optics of the projector, therefore reducing the radiant flux and associated heating on the SLM.

In conclusion, it should be noted that, while the preceding description relates to a particular preferred embodiment of the invention, the invention is not limited to this embodiment. A number of modifications have been indicated specifically and others would be apparent to a person skilled in the art. In addition, it should be noted that while the described embodiment relates to a projection system that includes three DMDs, projection systems

can be configured using different numbers of DMDs, for example, one or two. Different configurations are possible depending on the intended application of the projection system and the characteristics that are required of the system. Generally speaking, one and two DMD systems require time multiplexing of colour.

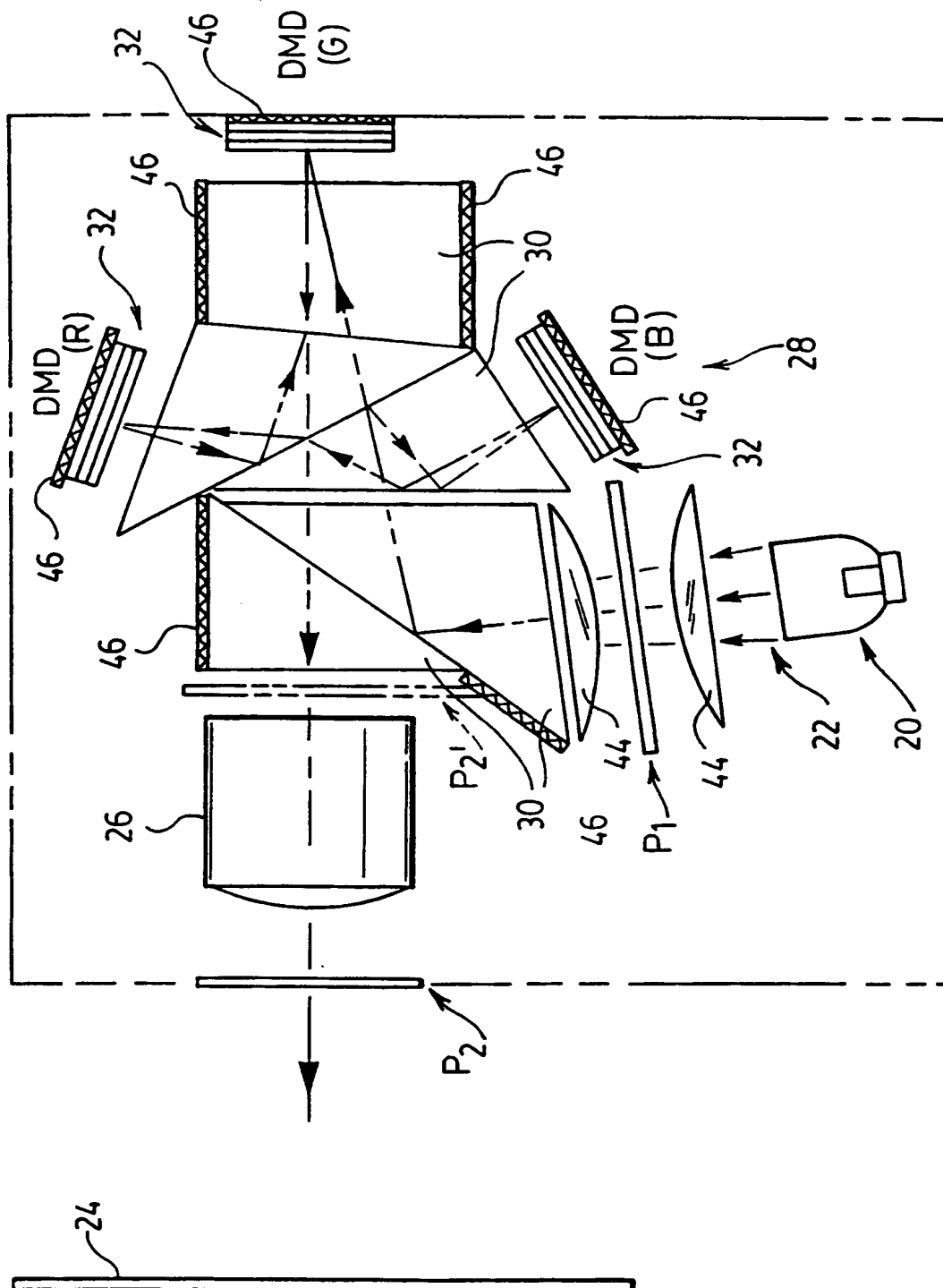


**WE CLAIM:**

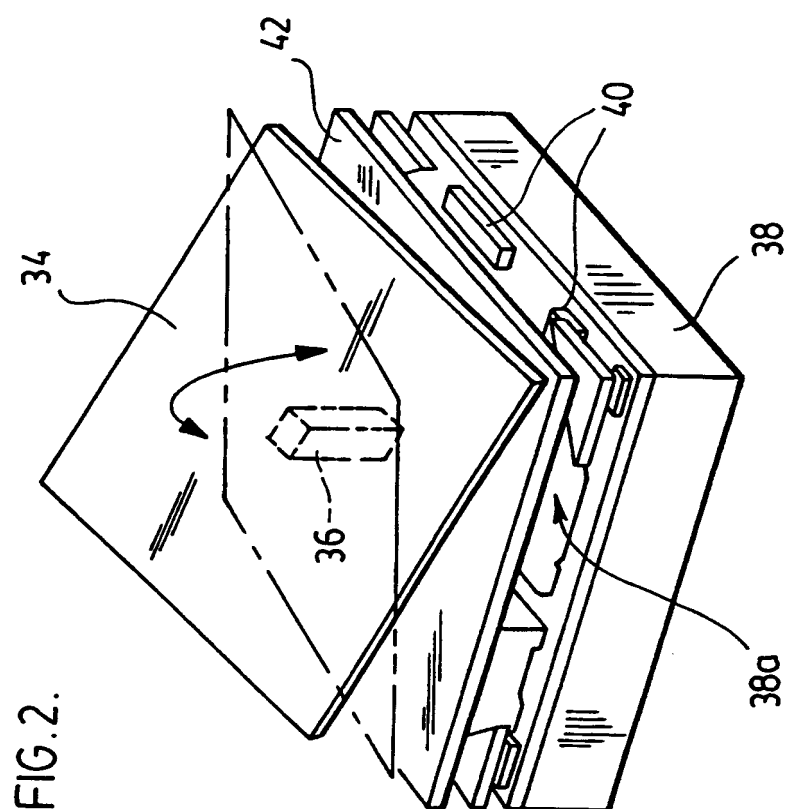
1. A projection system comprising a light source for producing a light beam, a screen, a projection lens for projecting the light beam onto the screen, and a spatial light modulator (SLM) for  
5 imparting image information to the light beam upstream of the projection lens, first polarizer means for polarizing, in a defined orientation, light leaving the SLM and second polarizer means for polarizing in the same defined orientation, light passing through said projection lens.
2. A projection system as claimed in claim 1, wherein the SLM is a  
10 digital mirror device (DMD), and wherein the first polarizer means polarizes light that is incident on the DMD.
3. A projection system as claimed in claim 2, further comprising a beamsplitter for separating said light beam into red, green and blue components (R, G, B) and delivering the components to individual DMDs and  
15 "reassembling" the components into a single light beam for passage through the projection lens.
4. A projection system as claimed in claim 1, wherein the SLM is a liquid crystal device (LCD), and wherein said first polarizer means comprises a polarizer forming part of said LCD.
- 20 5. A projection system as claimed in claim 1, further comprising means covering or coating reflective surfaces within the projector and adapted to polarize reflected light at an orientation orthogonal to the defined orientation of the first polarizer means.

1/2

FIG.1.



2/2



# INTERNATIONAL SEARCH REPORT

International Application No:  
PCT/CA 00/00800

A. CLASSIFICATION OF SUBJECT MATTER  
H04N9/31,G02B26/08

According to International Patent Classification (IPC) or to both national classification and IPC?

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
H04N,G02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5903388 A (SEDL MAYR) 11 May 1999, fig. 8, claims 1,4,5. --	1, 4
A	WO 98/00746 A1 (SIEMENS NIXDORF INFORMATIONSSYSTEME AG) 08 January 1998, claim 8. -----	1, 2

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
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- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search  
29 September 2000

Date of mailing of the international search report  
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Name and mailing address of the ISA

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**ANHANG**

Zum internationalen Recherchenbericht über die internationale Patentanmeldung Nr.

In diesem Anhang sind die Mitglieder der Patentfamilien der im obengenannten internationalen Recherchenbericht angeführten Patentedokumente angegeben. Diese Angaben dienen nur zur Unterrichtung und erfolgen ohne Gewähr.

**ANNEX**

To the International Search Report to the international Patent Application No.

PCT/CA 00/00800 SAE 292466

This annex lists the patent family members relating to the patent documents cited in the above-mentioned search report. The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

**ANNEXE**

Au rapport de recherche international relatif à la demande de brevet international n°

La présente annexe indique les membres de la famille de brevets relatifs aux documents de brevets cités dans le rapport de recherche international visée ci-dessus. Les renseignements fournis sont donnés à titre indicatif et n'engagent pas la responsabilité de l' Office.

Im Recherchenbericht angeführte Patentedokumente Patent document cited in search report Document de brevet cité dans le rapport de recherche		Datum der Veröffentlichung Publication date Date de publication	Mitglied(er) der Patentfamilie Patent family member(s) Membre(s) de la famille de brevets	Datum der Veröffentlichung Publication date Date de publication
US A	5903388	11-05-1999	US A	6034818
WO A1	9800746	08-01-1998	DE C1	19626097
				07-03-2000
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(19) World Intellectual Property Organization  
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(10) International Publication Number  
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(81) Designated States (national): AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

**Published:**

- With international search report.
- Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: IMAGE PROJECTION SYSTEM

(57) Abstract: An electronic projector has a projection system that includes a spatial light modulator (SLM) for imparting image information to the projected light beam. The light beam leaving the SLM is prepolarized in a defined orientation and the projected light is polarized in the same orientation so as to effectively block any light that has been scattered within the projector and become depolarized. The SLM may be a digital mirror device (DMD) or a liquid crystal device (LCD). Reflective surfaces within the projector may be covered or coated with material that polarizes the reflected light at an orientation orthogonal to the defined orientation.

WO 01/06796 A1

# INTERNATIONAL SEARCH REPORT

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